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# Home Warming and Ventilation





# HOME WARMING

—AND—

# VENTILATION:

## A Collection of Articles

BY

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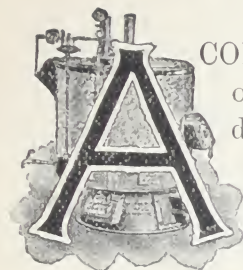
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## This Little Book Contains



COLLECTION of articles by authorities on Home Warming and Ventilation; men disconnected with business, thoroughly competent by study and experience to write upon these important subjects; men whose judgment is not biased by mercenary motive, who have no interest in the Herendeen Manufacturing Company.

It is our desire to present the most comprehensive collection of readable and thoroughly reliable opinions upon two subjects of vital moment to every man and woman.

If the reading of these articles suggests the using of our Furman Boiler, well and good. If it suggests any other boiler or any other apparatus of heating, made by any one else, the benefit recurs to others at our expense.

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## Modern Home=Heating.

BY NATH'L C. FOWLER, JR., BOSTON.

(NOTE—This article, signed "A Family Man," appeared in the International Journal of Surgery, New York, October, 1891.)

I am not a hot water man, nor a steam man, nor a furnace man, nor a fireplace man, nor a stove man. I have no interest in heating, except the interest of any decent man for a decent way of doing things, for I, like the rest of mankind, spend half of my life in the artificial climate of in-doors.

I am a family man. I live in a house of my own. I have lived in several houses which were not mine. I have kept warm, and shivered, and baked, and perspired with every kind of heating under the sun, and with the sun. I shall simply speak from experience, making no attempt to display a scientific knowledge, which I haven't.

There are five ways of warming or heating a house. The first is by the fire-place; the second is by the stove; the third is by the furnace; the fourth is by hot water; and the fifth is by steam.

### FIRE-PLACES.

A word about the fire-place. I would not have a house without one; I would rather have a house with a good many. A fireplace is an ornament. It presents a most cheerful fire, and gives to the room so much home-like beauty. It aids ventilation; but one might as well attempt to warm his house with a hot water bag as to try to warm it with a fire-place.

### STOVES.

The heating by stoves may be next considered. A house can be well warmed by stoves, if the stoves are good for anything.

The principal objections to stoves are simply these : A stove is a dirty sort of thing. It requires a large amount of care. It is almost sure to allow coal-gas to escape. It takes up unnecessary room. It must be taken down and put up twice a year, and it hasn't that air of respectability which modern housekeeping suggests. *A house can be heated but not really warmed by a stove.*

#### FURNACES.

Now to the furnace. I am willing to admit that theoretically a furnace furnishes a fairly good method of house heating. It is easy to take care of it ; it is located somewhere all in one spot ; it will throw off a generous amount of heat, if one burns enough coal. I am further willing to admit that a first-class furnace, properly constructed, and properly set up, with a scientific furnace expert engaged at a regular salary to run it, will heat two-thirds of any house anywhere, in a healthy and pleasant manner, although it is so inconsistent as not to heat the same two-thirds with any degree of regularity.

Ninety-nine per cent of furnaces are run by servant girls, and ninety-nine per cent of servant girls can play the piano better than they can run the furnace. I never knew of a furnace, including those which I have used myself, which did not generate and freely disperse coal-gas before it was three months old.

I never knew of a furnace which was not a coal eater with a ravenous appetite, or which kept my house warm in cold weather without being overfed. I was never able to heat over two-thirds of my house at one time, if there was any wind outside, so that the artificial heat in-doors would be even and general.

#### FURNACE REGISTERS.

I never knew of a furnace register which did not belch forth ashes and dust. I never knew of a furnace which did not use up the bad air in the cellar, if there was any bad air down there, no matter how well the air boxes were constructed, and I never knew of a cellar which did not have bad air, and plenty of it.



A furnace is nothing more nor less than a sort of stove located beneath the rooms to be heated. The air which passes through the furnace is more or less burnt, if the furnace is hot enough to heat the house. The furnace does not create a draft in the room, because the draft must be in the room if the furnace draws. I have never known of a furnace anywhere which would properly warm a house. It might heat a part of it at a time; it might even burn some of it; but there is a difference between heating and burning and warming.

#### MODERN METHODS.

Now I come to modern methods of warming — hot water and steam. I am using the former in my house, and the latter in my office, so I am familiar with both. I believe that hot water warming, properly constructed, is the most economical and healthiest and most convenient method of producing artificial in-door warmth. I almost think I know this, because I have experienced it. I am warming my house with the direct system; not because I have any objection to the indirect, but because the direct seems to me to be as good as the indirect, and is certainly more economical.

#### INDIRECT HEATING.

Simply to give a little information, which may not be possessed by every reader, I will state that the indirect system, so-called, consists of having coils or stacks of pipes placed in the basement, the air reaching these pipes by coming from the outside, through air boxes, passing over the hot pipes, and rising through regular register shafts through regular registers, into the room, while the

#### DIRECT HEATING

consists of having radiators in the room, the radiators being fed directly with the hot water, coming from the hot-water boiler. The radiators in my room are close to the walls, are not in the way, and, by neat and pretty decoration, are ornaments, rather than otherwise.

## TEMPERATURE.

The water in the radiators cannot reach a point higher than 212 degrees; I seldom allow it to get as high as 200 degrees. I can warm my house in moderate weather by bringing the water to 150 degrees. In the spring and fall I find that a temporary fire, even made of kindling wood, will bring the water to a sufficiently high temperature to take the chill off my house, and in no way make it uncomfortably warm.

## HOT-WATER SYSTEM.

The hot-water system can never burn nor overheat the air, for the extra radiation and the comparatively low temperature of the water distribute the heat evenly, warming every room throughout, without any room being much warmer in any one place than in others. The wind outside does not influence the effectiveness of the hot-water system, for the hot water will reach a cold room as readily as a warm one.

## NO DIRT OR COAL-GAS.

My house is entirely free from dirt and ashes. Coal-gas cannot reach any of my rooms. The temperature is always warm, never hot. The boiler is very easy to take care of; fully as easy as a furnace, and it does not burn over two-thirds as much coal to do what a furnace cannot do. The indirect system has its advantages over the direct, or, rather, certain people consider the indirect system more healthful, and that it furnishes more ventilation. Good judges, however, who have looked at the matter in an unbiassed light, are of the opinion that there is comparatively little difference between the two systems. If one is willing to go to the extra expense, and is much in favor of the indirect system, the indirect system is to be recommended. The radiators and pipes in my house are always filled with water, and can be filled in less than five minutes. Rusting is impossible, and I can, in less than five minutes, draw off all the water, removing all danger from freezing, should I wish to vacate my house in winter temporarily.

### THE BOILER.

I am using a boiler which seems to me to be the most practicable one on the market. This article not being an advertisement, I take pleasure in not mentioning the name of the same, but simply as a guide to others, who may not have experienced my experience, I will state that my boiler is constructed out of the best quality of cast-iron, which I selected for the reason that cast-iron will not rust out one quarter as fast as wrought-iron. This comparison of rusting has been established by scientific fact, and does not even need discussion. My boiler is made on the

### VERTICAL TUBE PATTERN,

presenting the most effective heating surface to the fire, and its upright circulation brings the water rapidly to the boiler, heats it rapidly, and rapidly sends it all over the house, returning it as rapidly to the boiler to be re-heated. My boiler is covered with three jackets. The outer one of galvanized iron, an inner jacket of sheet iron, and a thick lining of pure asbestos between the two. Virtually, it wears three suits of clothes, — a vest, a coat, and an overcoat, which act upon it the same as clothing does upon you and me, — keeping inside the heat, and preventing radiation.

### COOL CELLAR.

My cellar is always cool, the heat coming from the boiler being only sufficient to keep articles in the cellar from freezing. The smoke-pipe is cool enough to put your hand on it, with the hottest fire in the boiler. All the joints are "screw" joints, I having avoided the so-called packed joints, which are sure to rot and leak.

### STEAM WARMING.

Steam warming I consider substantially the same thing as hot-water warming, except it is not quite as pleasant, and is more liable to overheat a room. In steam warming it is necessary to bring the water to a boiling point to get any heat whatever, while

in hot-water warming, a low temperature will radiate a corresponding amount of heat.

From my own experience, I can say, that the methods of hot-water warming, reckoned on the standard of quality and economy, run in about the following order: Hot water, steam, stoves, furnace, and fireplaces.

Notwithstanding the inconvenience of stoves, I would much rather heat my house with them than with a furnace, for a great volume of even heat can be obtained from a stove. A stove will heat colder rooms, and I think stove-heat much more healthful than that which comes from a furnace. I would rather breathe over-heated room-air than over-heated cellar-air.

#### VENTILATION.

Ventilation is a subject much discussed, and not perfectly understood. I do not know how to ventilate a house, neither do I know of any one else who thoroughly understands it. It is either a lost or a prospective art. I do not see any reason why heating should be obliged to do the ventilating, because heating cannot do it anyway. Any architect or builder knows how to arrange lower as well as upper openings to drive bad air out the rooms. One of the cheapest and best methods of ventilation I know of is to have an opening near the baseboard opening directly into the flue, or some other outlet especially constructed for it, with hot water or steam pipes in this opening. A moderate degree of heat in these pipes will create a draft, and draw out the bad air from the rooms. Only a few of these pipes are necessary, and the amount of hot water or steam required to heat them is too small to be worth any consideration.

# Steam Heating.

BY WILLIAM J. BALDWIN, M. E., NEW YORK.

Within twenty years, the warming of buildings with steam carried through pipes has become a science; previously, it was a chaotic mass of pipes and principles.

A low-pressure gravity apparatus is the most healthful, economical, and perfect heating appliance known, and may be constructed to heat a single room, or the largest building, with a uniformity which cannot be attained by any other means.

By a gravity apparatus is meant one without an outlet, whose circulation is perfect, wasting no water, and requiring no mechanical means to return the water to the boiler. It may be likened to the circulation of the blood—the boiler being the heart; the steam-pipes, the veins; and the return-pipes, the arteries; thus carrying heat and life into every part of a building.

The low-pressure gravity circulation is at present very much used in the steam heating of private houses, churches, and schools. Its principal merits, when well done, are: It is safe; noiseless; the temperature of the heating surface is low and uniform; all the water of condensation is returned into the boiler (except a very small loss from the air-valves); it is easy to keep the stuffing-boxes of the heater-valves tight; and it is no more trouble to manage than a hot-water apparatus.

## BOILERS FOR HOUSE HEATING.

Boilers for house heating should have very few parts, and be as simple as it is possible to make them; every part of them should be constructed with a view to permanency; and parts that wear out more rapidly, such as grates, should be so arranged that they can be renewed by the most inexperienced person.

Requirements for house heating boilers are:

28. They should contain a quantity of water, sufficiently large to fill the pipes and radiators with steam to any required pressure, without lowering the water enough in the boiler to require an addition when steam is up: for should the steam go down suddenly, there will be too much water in the boiler.

29. The fire-brick should be set even with a water space around it, as in weight of locomotive boilers: to prevent clinketing on the sides, and the necessity of repairs to brickwork, which are unavoidable in brick furnaces.

30. The fire-brick should be deep below the fire-door to admit of a thick row, to last all night, and thus keep up steam.

31. The fire-brick should be sparrows, for the sake of good combustion.

32. The fires and tubes should be large and in a vertical position, so they will not foul easily, and so that any deposit would fall to the bottom.

33. The heating surface should be great in diameter, instead of in the direction of the chimney, and the last turn be a drop.

34. They should, if possible, be constructed of such shape and design, that they will require no sweeping or cleaning, other than removing the ash: for when it is unavoidable, every facility should be made for easy access to such parts: because that are often occupied by inexperienced persons (house servants) who will commit anything which gives them trouble.

35. The fire-grate must be easy to clean, (anti-clinker), and so designed that it will not break or break when heated.

36. The grate and ash-box must be so constructed, that a new grate can be put in quickly by any one.

37. There should be no tight corners in the chimney flue, but when the flue goes out near the bottom (drop flue), it may be depressed with alterations, but the fire and draft-ways should be made to flow straight (square), so as to be capable of entirely removing the fire. This will prevent the possibility of coals-gases escaping into the house: the shutting of a fire, by shutting off the



supply of air, is the proper way, for the draft of the chimney being unimpaired, draws all the harder on any crack, or crevice, in the brickwork, causing an inward current, which entirely precludes the escape of gas.

11th. The perpendicular height of the boiler should not be too great for the cellar, so the water line will not be too near the level of the main pipes.

## Ventilating and Heating.

EXTRACTS FROM PRIZE ESSAY.

BY ANSON W. BURCHARD, M.E., DANBURY, CONN., IN THE METAL WORKER'S BOOK ON HOUSE HEATING.

The importance of ventilation is universally acknowledged, and the connection of the heating of a house with its ventilation is so inseparable, that no heating apparatus which does not combine with it as thorough a system of ventilation, can be considered complete.

Every one who has had occasion to examine the subject knows that very few buildings are provided with efficient means of ventilation, and that however well the heating apparatus may be calculated to maintain the temperature at the desired degree in the coldest weather, in very few cases does it insure in connection with this an abundant supply of fresh air.

Where the question of expense and attendance does not enter the problem, to secure this supply of fresh air is not such a difficult matter, and many large buildings are fitted with appliances for this purpose, of a very complete description. Such apparatus requires the entire attention of an engineer, and are not, therefore, practicable for use in a private residence.

Hence, in designing an apparatus for such a house, any ventilating appliances that are adopted should be automatic, and the

movement of the air induced by the natural drafts of chimneys and hot flues; fans and other mechanical devices being impracticable because of the attention required to keep them in operation. In arranging appliances to afford this ventilation, one of the first points to be decided is how much fresh air will be required.

Perfect ventilation may be said to have been secured in an inhabited room, only when any and every person in that room takes into his lungs at each respiration, air of the same composition as that surrounding the building, and no part of which has recently been in his own lungs, or those of his neighbors, or consists of products of combustion generated in the building, while at the same time he feels no currents or drafts of air, and is perfectly comfortable as regards temperature, being neither too hot nor too cold.

Very rarely can such ventilation be secured if the number of occupants of a room exceeds two or three.

Without entering into a discussion of the methods and expense of securing perfect ventilation, good ordinary ventilation is to be secured by keeping the vitiated air diluted to a certain standard. All air with which ventilating appliances have to deal contains more or less impurities, some of which are more dangerous than others, and are less affected by this process of dilution. Of these impurities, carbonic acid gas is popularly supposed to be the most harmful, but as a matter of fact, it is not poisonous, and produces no harmful effect, even when present in 30 to 50 times the normal quantity. But this carbonic acid is generally found accompanied by other gases which are harmful, particularly carbonic oxide and sulphuretted hydrogen. Hence, as there is no convenient method of determining the percentage in which these two latter gases are present, it is usual to determine the percentage of carbonic acid present, for which there is a simple method, and assume that the amounts of the other gases present are proportionate to this.

As a rule, an apartment may be considered well ventilated when a person entering it from the fresh outer air does not perceive any



special odor, and experience has shown that a faint, musty, unpleasant odor is perceptible under such circumstances, if the amount of carbonic acid of which the normal is about four parts in 10,000 of air, be increased to above seven parts in 10,000. If the air which has been used and contaminated did not mix with the air in the room a comparatively small quantity of fresh air would be required. Basing their estimates on this erroneous assumption, some authorities have concluded that 250 cubic feet of air per hour for each occupant is all that would be required.

But as the contaminated air does mix with the fresh air, it is found that, in order to keep the carbonic acid diluted to seven parts in 10,000 of air, a supply of about 3,000 cubic feet of fresh air per hour is needed for each occupant, where rooms are occupied continuously.

The rooms of dwelling houses are rarely occupied continuously, and there is a large amount of air constantly being admitted through the accidental openings, as floors, windows, cracks, etc., so that a supply of 2,000 cubic feet per hour for each occupant is sufficient.

## Hot-Water Circulation.

FROM PRIZE ARTICLE.

BY RICHARD SHALWELL, IN THE METAL WORKER'S BOOK OF HOUSE HEATING.

After an experience of many years in the planning and fitting up of heating apparatus, the writer is of the opinion that hot-water circulation is the best known medium for heating buildings, whether large or small. Whether situated in a climate where the thermometer seldom registers zero, or in a climate where the mercury for months seldom rises above zero, and where 45 degrees below is not uncommon, hot-water circulation, in the writer's experience, has given and is giving satisfactory results, both as regards efficiency

and economy. As a system of heating, hot-water circulation possesses advantages which recommend it to all interested in heating apparatus. It is easily managed. Ordinary help is all-sufficient. It is perfectly noiseless. No pounding or hissing sounds. It produces a steady, mild, equable temperature throughout the building. No overheated or burnt air. It is economic. The circulation starting as soon as the fire is lit, transmits heat at once to radiators, and it can be easily regulated to suit the weather. It is wholesome. No coal-gas, dust, or vitiated air. With ordinary care repairs are *nil*, while complete command is obtainable over all or any portion of the apparatus, any desired reasonable temperature — with a well-proportioned apparatus — is easily obtained. In the writer's opinion, the direct system of heating is the best for the following reasons: The occupants of the different rooms have, with the direct system, easy access to and command over the heat supply of their respective radiators, while with the indirect system it is difficult to adjust the register valves to obtain the same result. Again, should an indirect radiator or coil be turned off by closing the valves and the water it contains not be drawn off, there is the danger of freezing, owing to the cold air having access to the inclosure in which it is placed.

The indirect system is not as clean or healthy as the direct, as dirt is liable to accumulate in the ducts and register-boxes during the summer, to be delivered to the rooms during the winter months, vitiating the air supply. The radiators should be of cast-iron, as this material affords a more pleasing form of radiator than box-coils of wrought-iron pipe. Again, though box-coils are, in the writer's opinion, rather more effective foot for foot, as commonly rated, in radiating power than cast-iron radiators, yet box-coils are open to the objection that dust, fluffy matter, etc., accumulate on the upper side of the pipes, and in a comparatively short time seriously interfere with their heating capacity. This is especially the case where box-coils are covered with ornamental screens and marble slabs. The writer has on several occasions examined heat-

ing apparatus that had become ineffective, and found the upper side of pipes coated with an accumulation  $\frac{1}{2}$  inch to  $\frac{3}{4}$  inch thick, which resembled in texture and appearance a loose felt. This matter proved a good non-conductor, as after its removal the apparatus worked efficiently. For these reasons the writer prefers using cast-iron radiators, preferring those that have the least receptacle for accumulating dust and that are easily accessible in all parts, allowing of daily cleaning or dusting, as with any other article of house furniture. Wall coils of wrought-iron pipe are not open to the above objection, and where they can be suitably used are cheaper than cast radiators, and as they consist of a single row of exposed pipes, can be easily kept clean. Wall coils, when neatly set up on ornamental plates and nicely bronzed, look fairly well, and it has been the writer's practice to use them on upper floors and basements where suitable wall space could be obtained.

## Hot-Water Circulation.

FROM PRIZE ARTICLE.

BY JOHN HOPSON, JR., IN THE METAL WORKER'S BOOK ON HOUSE HEATING.

One reason why I prefer warming the house by hot water instead of by hot air or by steam is that, having had experience in the use of all these in different houses I have lived in, I consider hot water preferable to any of the others.

Public opinion or common talk has always been recognized as a factor in determining the truth, and the progress which hot-water heating has made among users in the past few years is an argument that the growth of the art has evolved its merits.

It is open to the atmosphere and absolutely safe; it is also noiseless. Technically, I view it as the best, because the source of

warmth to a room or house, either by the direct or indirect method, is at a lower temperature than that of hot air or steam. The heat from it by either method is often designated as being soft and mild. Its low temperature changes the quality of the air, as to humidity less than either of the others. This reason of a lower temperature, together with the fact that water is a steadier and more reliable vehicle for the conveyance of heat, forms the chief reason why it is more economical than any other.

It therefore accounts at the radiator and in the place where it is intended to be used for more of the units of heat generated by the fire, and is the most economical in the use of the fuel consumed. It is my belief that while the hot-water plant will cost the most of the three, even if all are as well erected of their kind as they may be, the hot-water plant will prove the most economical in the end, maintenance and repairs being taken into account.

## A Modern Household Angel:

IT IS THE BURNING TOPIC THAT CONCERNS THE MARRIED MAN.

BY ALLAN FORMAN, EDITOR "THE JOURNALIST," NEW YORK.

About this time of year the married man, who is also a householder, finds just one absorbing topic of conversation which he discusses with others of his kind. He may speak incidentally of stocks, politics, business, the probabilities of war in Europe, or the difficulties attendant upon getting a good cook, but if you want to see him really interested and animated, gently lead the conversation to the subject of house warming and furnaces. Then the most taciturn of the guild becomes eloquent.

I've been visiting some friends in one of our fashionable suburbs, and I ride in and out of town, morning and evening, on the train with my host. Our fellow travellers are all regular "com-

muters;" they all know one another and they all talk furnaces. My ideas formerly on that particular subject had always been rather indefinite. I fancied that a furnace was a contrivance of some sort, located in the cellar, and supposed to heat the house, give off gas and dust in about equal quantities, and afford the servants opportunities for making an unearthly noise about four o'clock in the morning.

My method of regulating furnace heat has been to blow up the landlady. I have always preferred the system of steam heating, which I have in my office, because I have found it more effective to scold the janitor than to remonstrate with the landlady when the room was filled with gas and dust, and the mercury was trying to keep warm way down in the bulb of the thermometer. The janitor would go off and fix things, while the landlady always had some irrelevant excuse about the cook having burned out the grate, or the packing in the pipes leaking, or some similar matter. There seemed to be a continual warfare between the various cooks and the furnace, a sort of vendetta which attached to the position. From frequent conversations with my landlady I became convinced that the furnace was a highly complicated mechanism, something like a watch, only less easy to regulate.

I also took a solemn oath, that if ever I should be obliged to run a house I'd abolish the furnace and heat it with fire-places, which are cheerful, cosy, and picturesque. I made some such remark to a family man of my acquaintance, who asked me to take care of his house for him while he made a winter trip to Florida. He laughed, and gave me the permission to try the experiment. The open fires were pleasing to the eye, but they did not heat the rooms. After sitting in front of one for two evenings, with my face baked and icicles forming on the back of my neck. I told the servants to light the furnace. During the rest of my stay, as temporary master of the house, I had general supervision of that furnace, and the way it devoured coal, made gas, belched forth dust, warmed part of the rooms and refrigerated the rest, in fact,



the laundress' assistant? was responsible for the unwelcome look had at that time. Consequently I sympathized with this village school of missionaries who right and trusting devoted their energies to working forward.

"Do you know why so many men stay away from church?" asked looking fellow-passenger asked me one morning. I said:

"Well, it is because they look forward with joy to going to places which will be warm, and where they won't be bothered with laundress."

I never saw but one man who was satisfied with his system of laundressing, and he is an extraordinary man, so his testimony hasn't very much weight. I rode on to Boston but other it with that feeling, and as he has just built a house, of course we went to see—talked about laundressing. He has a better house wherever that may be, which is endowed with almost human intelligence. He explained to me that it got up a system itself by the pressing, and shook out the own action had caused me that it paid all its own coal bills. He says that he spent some money, and I hoped few more thousands of it later, in testing various kinds of heating arrangements, and so he has the best in the world. He says he has a machine, which has between holes by his pillow. Curious, because it will work out, evaporate, as fast as steam-heating, and without any means that provide the most effective heating surface to the feet and tend to circulate the warm water rapidly through the house.

He says he has a control with these pockets, so that a valve is always open, and the joints are all covered joints and the windows do not leak. The radiators are beautiful and water-proof of heat. They have all the water at a temperature of a *large* amount, and the water can be drawn off in five minutes, and be within to shut up the house. Just after talking the story of my own, my friends, the missionary, I can't believe that any man who would ever want to shut up or leave a house

that had a heater in it like the one that Fowler describes. He would rather go down into the cellar and sit beside it and pet it, and bring it bouquets, and write sonnets in its honor.

It is one of the regrets of my life that I was so fascinated by Fowler's enthusiastic and lover-like description of his vertical tube, cast-iron boiler that I neglected to ask its name. If I knew what it was I should feel that I was conferring a boon upon furnace-tormented humanity by giving this marvellous heater a free advertisement.

When the suburban resident is released from the thralldom of the lawn mower, and begins to dally with the poker and coal shovel, the furnace is the "burning" topic in more senses than one. If ever the whirligig of time and circumstances should bring me a house of my own, I'd either get a hot-water machine, such as the one Fowler described, for it, or I'd move South.

Married men and householders have some trouble which bachelors and dwellers in hotels know nothing of, and not the least among them is the fiend in the cellar — the furnace. The man who can transform it into a household angel is certainly a benefactor to the human race.

## Ventilation and Heating.

BY JOHN S. BILLINGS, M.D., LL.D.(EDINB.), SURGEON U. S. ARMY.

THE great majority of hot air furnaces as actually used are unsatisfactory, and special sources of danger to health, but this is not so much the fault of the furnaces themselves as of the manner in which they are set and adjusted. They are better than stoves in this respect, that satisfactory heating cannot be secured by them without the introduction of air into the room to be heated, but the air that is introduced by them is often of a very unsatisfactory quality.

In 99 cases out of every 100 buildings in this country in which this method of heating is used, the furnace is too small. The result of this is, that in cold weather, in order to secure comfort it is necessary to raise the radiating surface to a high temperature, often to a red heat. The contraction and expansion due to such great changes of temperature soon loosen the joints of furnaces built up of several pieces, and permit the escape of the gases of combustion into the fresh air supply. Of these gases, carbonic oxide and sulphurous acid are the most hurtful.

As furnaces are usually set, there is no provision for mixing cool air with the heated air. The result of this is, that the air is delivered in the room at a high temperature — often at 140° F., and sometimes higher — and the only way to prevent the room from becoming too warm is to close the register, which, of course, shuts off the supply of fresh air. I shall have occasion to allude to this again in discussing the subject of moisture of the air.

The source of air supply to a furnace is often very unsatisfactory. Sometimes it is taken directly from the cellar itself, in which case it is almost sure to be contaminated with gases escaping from the furnace door, while the cellar itself contains decaying vegetables, slop buckets, and perhaps an empty sewer trap, giving free communication with the sewer; or the air box from the outer air to the furnace, passing through the cellar, may have so many cracks and loose joints, that the cellar air finds an easy entrance to it.

## Fire-Places and Chimneys.

BY J. JENKINS.

According to recent reports of the Fire-Marshal, two-thirds of the fires in New York City are traceable to the use of hot-air furnaces; and the evil is increasing to such an alarming extent, that the fire insurance companies of New York City have been compelled to in-



crease the rates of insurance where they are used, and to offer a premium on safer modes of heating.

Many persons complain of the quality of the heat they obtain from their furnaces. In many instances their complaints are groundless. Many furnaces are so constructed that after being in use for a short time their joints get open and gas leaks into the air-chamber. This is a very unpleasant as well as unhealthy effect. The joints in these instances are usually formed by bedding two flat surfaces together, with cement between them. As one part usually heats and cools quicker than the other, the unequal expansion and contraction of the iron will soon loosen the cement, allowing it to work out and form a crack, through which the gas escapes to the air-chamber.

#### SUMMARY OF LOSSES.

From the foregoing facts we see that the following losses may and do occur in ordinary stoves, furnaces, etc. :—

- 1st. The escape of free hydrogen, an invisible, combustible gas.
- 2d. The heat expended in generating this gas.
- 3d. The escape of carburated hydrogen, an invisible, combustible gas.
- 4th. The heat expended in generating this gas.
- 5th. The escape of bi-carburated hydrogen, an invisible, combustible gas.
- 6th. The heat expended in generating this gas.
- 7th. The escape of carbonic oxide, an invisible, combustible gas.
- 8th. The heat expended in generating this gas.
- 9th. By the formation of ammonia, a serious hindrance to the process of combustion.
- 10th. The escape of solid carbon, a valuable heat-giving element.

The escape of this carbon is occasioned :—

- 1st. By an insufficient supply of air

2d. By too great a supply of air.

3d. By the want of a proper distribution of air throughout the burning mass.

4th. By bringing such quantities of cold air in contact with certain portions of the fuel as to reduce the temperature below the burning point.

## Ventilation and Warming.

BY A. N. BELL, IN "THE SANITARIUM."

Among the controllable causes of ill-health in temperate and cold climates, an excessively variable or foul in-door atmosphere due to defects in the modes of ventilation and warming, is among the most prolific. And it may be accepted as a general truth, that no system of warming inhabited buildings which does not include arrangements for effectual ventilation should be adopted; hence the necessity of considering these subjects under one head.

The air, in a state of purity, mainly consists of two sorts of gases — oxygen and nitrogen — in the proportion of one part of the former, or about 21 per cent, to four parts of the latter, or about 79 per cent; of carbonic acid, about four parts in every ten thousand, and watery vapor in variable amounts — rarely more than one-sixth, and rarely less than one two-hundredth of the whole bulk. The practical maintenance of these proportions of the atmospheric constituents should be the primary objects of all means of ventilation and warming.

The whole quantity of air actually respired by a healthy adult in 24 hours is about 400 cubic feet. This contains, when once passed through the lungs, about five and a half per cent, or one hundred times more carbonic acid than it did before it was respired, and is saturated with watery vapor, no matter how dry it may have been when taken into the lungs.

Moreover, it should be observed that the mere space allowance

should in no case detract from the absolute necessity of means for renewal of the air, and the smaller the space to be ventilated, so much the more certain should be this provision. If 300 feet only be allowed, the air must be changed at least every twenty minutes. To neutralize the deleterious properties of respired air and replenish it, every person requires 2,000 cubic feet of fresh air hourly; and with less provision than this, contamination is sure to follow.

To permit the passage of 2,000 cubic feet of air hourly in ordinary atmospheric movement, requires an opening of five inches in the square; and in closed rooms two such openings, one for inlet of pure air, and the other for the passage out of that which is impure. It is apparent, therefore, that for a single occupant of a room 300 cubic feet capacity, requiring a renewal every 20 minutes, three times as much open space is necessary, and special protection from draft, by means of covering; for it should be borne in mind that the estimate for dormitory occupancy only means for the night—not more than eight hours—a liberal proportion of the amount (800 cubic feet) deemed to be sufficient for occupancy day and night, and susceptible of efficient ventilation without dangerous draft.

#### VENTILATING FLUES.

To meet the changes and conditions of artificial temperature, experience shows that escape flues for foul air should be both near the floor and near the ceiling, and flues for entry of fresh air four to five feet above the floor and on opposite sides of the room from the escape flues. When the weather is cold, the escape flues at the top of the room should be closed; when it is warm, open. Those near the floor should be open at all times, and, these, the exhaust flues, should be warmed by a gas jet, or a line of steam pipe, to make them draw the foul air. With the heating so arranged, by steam or hot-water pipes, as to keep the floor warm—which is the most healthful of all means of warming—the

except that in this air should be exactly confined to a level with the ceiling, surrounded with a heated box.

#### WARMING

The different method of warming may be divided into the direct, then fireplace, stoves, including furnaces and tanks, and hot water. The same universal of all solutions is required, according to cold climate—no matter what the most important—is to estimate the amount of fuel and heat producing capacity which will be required to warming. Ventilation is equally essential—air must not be allowed to be absorbed without expenditure of fuel. And the smaller the space to be warmed—the greater the amount to be heated of occupants—the larger the proportion of heat required for ventilation. But the greatest reason that the air has to be changed must frequently.

There should seldom be less than 80 to 90 per cent of the heat produced and lost through the cracks pipe only about as much as the open fireplace losses—50 to 70 per cent. And hence the necessity of different sections and various thicknesses of the glass, plate heated by a steam stove and an open fireplace. The amount of air which passes through a steam stove, heated with fuel fire, is at its average equal to only about one-fourth of the quantity of the room warmed, and consequently such stoves require a limited, but have no effect a change of atmosphere in every case apartment. These stoves will heated, the air be taken into with the temperature of respiration and continued throughout.

Hot-water Furnaces are simply radiators placed outside to be connected to be gradually and usually in volume or movement of the following is which they are used.

#### WARMING BY WATER AND HOT WATER.

There has to that point is accomplished by means of hot presented in the furnace of a boiler, either within or without the building in which it is applied, the heat being dependent upon

water, which is vaporized and the steam generated thereby distributed in small pipes as the medium for imparting the heat. Steam-heating is divisible into two methods: direct and indirect. The first or direct method corresponds to the heat by stoves; and the indirect corresponds to hot-air furnaces. In the direct method, the heater stands in the room which is to be warmed, and consists of coils of pipes, incased or otherwise, or ornamental boxes. In the second, or indirect method, the coils or lines of pipe are placed in the basement or cellar, or in flues in the walls, and the fresh air is warmed in the same manner as when it passes over a hot-air furnace. The special advantages of steam heat over stove and furnace heat are the facility with which it may be applied to large buildings; avoidance of the foul gases which may escape from an overheated or imperfectly regulated stove or furnace; and, when the boiler is outside the walls of the building to be heated, freedom from the risk of fire.

Hot-water heating is effected by the circulation of hot water through a system of pipes so arranged that the water, as it is heated, flows in accordance with the laws of specific gravitation. It may be distributed with the same facility as steam, over any extent of area, and has the advantage of communicating heat immediately that the hot water begins to flow—in much shorter time than is required for converting it into steam.

## **Our Dwellings Warmed:**

AS THEY ARE AND AS THEY MIGHT BE.

BY J. W. C., LONDON.

With the hot-water system, the ventilation can be brought to much greater perfection than on the old open-grate system, in spite of would-be knowing people always harping that the old grates are healthy, and for this reason ought to stand against all comers. They ventilate the rooms, say these people—just as if the rooms



could not be ventilated with any other system of heating. That they extract an enormous amount of air from the room, on exactly the same system that the furnace at the bottom of the upcast shaft of a coal pit draws the air out of the pit after it has traversed all parts of the mine. I do cheerfully admit, that, were the sole duty the fire had to fulfil to draw a vast amount of air from the room, it would certainly do it as well as any contrivance that could well be proposed, except air were to fix centrifugal fans, as now coming into use, for ventilating collieries in the North, for the purpose. We must first see what ventilation really means, before we can decide whether the plea for the open grate — that they do ventilate the room — is worth anything or not.

Dr. Arnott in his admirable work on "Ventilating and Warming" justly observes that — "In sitting-rooms, bedrooms, nurseries, and finished places generally where people assemble, the impure air of the hearth, the burnt air from lights, odor of dishes, &c., because heated, and therefore specifically light, all ascend first towards the ceiling, but as no opening exists there, in ordinary rooms, for escape (for an open windowing in a room which has an open fireplace only admits the cold air,) they soon contaminate the whole air of the room above the level of the chimney-mouth, through which only our sky portion ultimately passes away. In this way arises great, though often unperceived, injury to the health, and finally, to the constitution of the inmates. The pale faces and scrupulous habits of the inhabitants of houses, and others who live much within doors, are healthy effects of this evil."

My definition of ventilation is this — that we shall remove the impure air from the room at a part of the room where the impure air is, and replace it with fresh air from outside, in such a manner and quantity, and at such a temperature, that the occupants shall not feel the change. Assuming this definition to be correct, we may now ask — Does the open grate do this? Does the open grate remove the vitiated air from the room? Emphatically, I say — No; it does not! The vitiated air occupies the upper part of a

room, and this is just the part the open grate has no power over, as far as removing the air from it goes. Does the open grate introduce the pure air in such a manner and quantity, and at such a temperature, that those in the room do not feel the change? Need I answer the question? The open grate merely exhausts pure fresh air from the lower three or four feet of the room — air which has only just come into the room, under or around the door or window, and which, when in, makes straight for the chimney throat. This air is never in the room long enough to get contaminated; it is in at the door, and away up the chimney, in often less than 10 or 12 seconds. Half a dozen lighted candles, placed on the floor of any room, will show the direction of the air-currents by the direction the flame takes. If the air is still, the flame should be quite upright; and this simple experiment will show us why open grates can never properly warm a room.

So much for the much-vaunted and overrated ventilating power and healthfulness of our open grates. As far as they go, their efficiency at warming and ventilating are about on a par. With the hot-water system, the fresh air is admitted under the hot pipes (properly regulated), and, passing amongst them and around them, it enters the room warmed and pleasant; and the vitiated air is withdrawn into the boiler or kitchen flue by means of a ventilator placed in it near the ceiling. It has been asserted that hot-water pipes give off a dry heat. This, as far as it goes, is true; but the dryness is very different when coming from pipes at 150 degrees to that coming from a stove at, say 600 degrees. A certain amount of dryness is inseparable from any heat, unless we have evaporation; and that arising from hot-water pipes is none too dry; and will be found beneficial rather than otherwise, except in severe dry frosty weather, with the wind N. E. The excessive dryness of the air then renders the evaporation of a little water advisable every day, but it should not be overdone.

In many churches, concert-rooms, theaters, and other public buildings, we see elaborate means adopted for withdrawing the

bad air from the ceiling by means of the skylights, etc., but how  
very seldom do we see any provision made for the admission of  
fresh air to take the place of the bad air withdrawing; and yet it  
needs no argument to prove that the bad air cannot make the exit  
unless some other air comes in to take its place; and yet this simple  
fact is ignored, or nearly so, and consequently we get no benefit  
from those means taken to ventilate the room, because  
they are incomplete. Given a theater, or other public building,  
to be ventilated in such a manner that 2000 persons shall breathe  
in those lower seats with comfort: how is it best to be done? That  
fresh air must come into it, and the impure air pass out of it,  
needs no common sense. It is the mode of introducing the fresh  
air so that by breathing shall not be felt, that is not so well under-  
stood; it should be given to those who ought to know. A body  
of cold air introduced into the above room through a pipe, say six  
inches in diameter, would rush in with such force that it would  
be felt fully 50 yds. from the ceiling, and would also give every  
body a cold and tell good who sat opposite to it to that distance. If  
the above jet of body of air were introduced into the room, not in  
a body, but through some one who passed, say 20 holes to the  
wall, the incoming would not be felt three feet away; and were it  
warmed to 55 degrees it would not be felt at all, provided  
there was plenty of introducing sufficient air to the room, which,  
of course, one hole per person would not be; indeed, it is questionable  
whether ten holes per person would be enough without passing the  
air to some through the ground fast enough to cause a draught.  
It would require a piece of ground, as above described, two feet  
long to be put just in front of each air as a flue pipe would  
require. The great trouble up the stream of air is the same way  
as a candle on a water-tight board by the stream of water; and,  
of course, the smaller the stream the air or water is broken up  
into the less they will be felt. All that now remains is to warm  
the incoming air to a suitable temperature by passing it around  
hot-water pipes; and you may introduce as much as you like into



the room, and no one will feel it. You can change the entire atmosphere of a room or theater in this way three times an hour, without difficulty; and, barring the fact that people breathe comfortably and have no headache, no one would know that fresh air was being admitted at all. It must be borne in mind that enough air must be admitted, or the evil is only modified, and not removed; and it is far better to have too much than too little air admitted. By gradually lowering the temperature of the incoming air, the temperature of the room can be kept at any desired point; and in summer time it can be passed around and among blocks of ice, and cooled in that way; so that the theater or room can be kept even cooler than the open air. Were this done, it is probable that theaters would pay better during the summer months than they do now, and pay the trifling expense in adopting this system over and over again. Probably, also, "The Ghost" would be more inclined to walk at times than he is now, if he found the temperature more suitable to that healthy exercise. The importance of good ventilation is even greater than that of warmth, as we can protect ourselves against cold by extra clothing, whereas there is no protection against bad air. The mischief the latter does is hardly ever realized by any except a few deep-thinking members of the medical profession. It is believed, and I think with reason, to be a great developer of that scourge of our race; viz., consumption; and there can be no doubt it begets bad blood, and this lays us open to numberless ailments which, once in possession, are very difficult to get rid of. The difference between the faces of the poorer children in London than those in the country — the pale, wan faces of the one, and the fresh, chubby, healthy faces of the other — should be enough to convince any one of the value of pure air.

In conclusion, I have only to add, that doubtless many will remark that I have suggested nothing new, or not before known, which is quite true; but my object has been not to suggest any new or untried system, but to make known to the million the advantages

of a system hitherto known to a comparative few— which system is so near perfection, that the prospects of any better one being discovered are exceedingly remote. As the Warming Problem is now attracting so much attention, I thought it behooves those who may wish to solving it to do my part of this little work should be the success of placing us one step nearer the solution of the difficulty, I shall be abundantly rewarded for my pains.



## Furnace and Furnace Materials.

FROM THE "AMERICAN ARCHITECT AND BUILDING NEWS."

FURNACE makers will claim that the peculiar kind of cement they use, or the peculiar method of hammering the joints, will prevent leakage of gas. The writer visited a furnace advertised by the makers to be absolutely gas-tight. The joints were numerous. In some joints cast-iron was connected with wrought-iron, and pipes of cast-iron were set into wrought-iron plates. To this the writer particularly objected, and inquired of the makers if they could warrant the furnace to stand test at these points. The method of working these joints was, they claimed, peculiar. No cement was used, and so great was the care bestowed on each joint that leakage was a sheer impossibility. A fine new furnace was exhibited to show the excellence of the workmanship. The writer still objected, until challenged by the makers to give proof of any of the numerous furnaces put out by the company, having ever leaked gas. With the assurance that I was at liberty to make any reasonable test I pleased, I ordered the furnace to be turned over and water poured into all the joints. To the complete astonishment of the proprietors and of the careful workmen standing around, the water which was poured in, poured out again through nearly every one of the score of careful joints, until the furnace seemed to dissolve, and float away in its own tears.



# Ventilation.

CONDENSED FROM EXPERIENCE.

BY MESSRS. LORING & PHIPPS, ARCHITECTS, BOSTON.

THE common idea that, a circulation of fresh warm air within our buildings is as cheap as water, and that all architects should be severely condemned for not providing same, at no expense to the owner, is now exploded; if desired, it will cost something. The world of the present day is not the world of twenty-five years ago; neither are our clothes, our food, our surroundings, our houses, or our heating apparatus. The houses, more particularly, are better built, tighter and warmer, therefore, it is especially desirable that fresh air should be furnished to the occupants, and that it should be properly removed, economically and without drafts. This country of ours contains, without doubt, more homes with home comfort than any other, but they lack ventilation.

You may heat your building with steam or hot water as a power, but there is no excuse for killing the inhabitants inch by inch for the want of fresh air, as it is not yet monopolized or in the hands of a syndicate.

It is possible to properly and surely ventilate any building. The average person expects this result to be accomplished by punching holes in ceilings, to dead air top-lofts or by a hole in the wall. It is proper to say in the beginning, that any correct system of ventilation for a building requires more fuel than one without such system. All buildings, being designed to fit the necessities of the situation, differ in plan from each other, and in order to introduce a ventilating apparatus, each should be studied by one who is familiar with all kinds of plants, as it requires skill to so fit it in place as not to invite criticism from the artistic standpoint.

It is possible to put in a system properly in old buildings, but it entails more expense in proportion than for a new building. We

do not propose to make any radical changes in internal arrangements, or in any way interfere with the business end of household affairs, and the apparatus will not attract attention, be unsightly or objectionable in any way.

If you have a family you are educating them at considerable expense, you feed and clothe them, but what do you do for their physical welfare? You are preparing your children for the competition of life, mentally, and at the same time weakening them by the impure air they breathe.

The manner of introducing fresh air to the heating plants varies from natural pressure of atmosphere to the use of fans. For public buildings the fan is essential, for private dwellings it is not necessary. The system without a fan is called a gravity system. In our arrangement for ventilation we use the direct exhaust in contradistinction to the indirect, the direct being cheaper to construct and more certain in its operation. If the fan is required it may be run by motors operated by water, gas, or electricity, and does not require any skill. If the fan is located in basement (as it ought to be) it is used for pushing the air forward to the heating surfaces during the cold season; in the summer time it may be arranged so as to reverse its movement, and bring fresh air from above the roof down through foul air ducts into rooms, and out of warm air inlets through fresh air inlets to the outer air, a complete reversal of the winter system.

Heating by steam or hot water is absolutely sure; there is no guess work about it; it depends only on the power used and the mechanical application of it. In competition between bidders for heating work, the owner should protect himself by dealing with a house of first-class reputation, or, what is better, to have a proper specification written by an expert, and so have them all figure on the same basis.

We believe that the correct movement of air in a room is to have the fresh warmed air enter the room above the breathing line, on an inner wall surface, and the outlet for foul air be on the

some must well surface at the floor, and this may be in the form of a trapdoor; the air in this manner is diffused all over the room, just as it comes in contact with exterior walls and glass surfaces of windows, roofs and falls to the floor, and the pressure on the same continues it along to the outlet.

The stacks or low walls of such a system should be provided with moving dampers controlled separately and independently in each room so that the occupant can have fresh air, fresh warmed air, or none, leaving the servant only to attend to the firing of the hearth.

A simple label of good proportions at several inlets, for fresh air should be provided in each stack or roof, and they should have convenient wind breaks so that neither the servant nor any one else is required to wait the fussiness of every change of velocity or direction of the wind.

Forcing ventilation is a fact which many people believe to be an impossibility, and others look at it as a bad; to the latter we would say that with such a system as above you need never open your windows for fresh air; in fact, the opening of a window in the cold season seriously interferes with the perfect circulation of the system.

## Healthy Houses.

BY WILLIAM MORRIS, F.R.S.E., F.R.S., F.R.I.B.

THE notion of hot air with a response, is not likely to prove of any service to the householders, who would stand against at the amount of waste and wear and tear, which the system would entail upon him if performing ordinary work with such a gross load. For a similar reason, I will not enter upon the warming of the rooms by the heating of the smoke and heated gases through the pipes, instead of hot air. It would be amusing to see the mismanagement of the serving man, who had received in-



ders to clean out the flues and passages, after a few months' working, and had got just far enough into the work to be able to estimate its endless inconveniences.

It must be conceded, to begin with, that heating by hot air is not to be recommended when heating by means of hot water can just as well be adopted. The hydrometric and electric conditions of air are so altered by its being burnt or dried up, that serious annoyances, and even diseases, have been known to follow an injudicious method of hot air warming. Some physicians altogether condemn its adoption where life is concerned, and have gone so far as to affirm that it is the prime mover in the decomposition of many deleterious bodies floating in the air, the particles of which would be perfectly innocuous, if not resolved by this peculiar heat into their original gases; we mean the cerberus monster of chemistry, sulphuretted, phosphoretted, and carburretted hydrogen.

#### HEATING BY STEAM.

The only system that can for a moment compare with that of hot water, is the system of heating by means of steam confined in suitable radiators. To properly compare these different systems would, however, be a tedious task, and hardly called for here. The chief advantage of steam over hot water is, that less heating surface is wanted for the former than for the latter. Steam heating can also be advantageously adopted where there is a surplus of steam from the engine boiler, or waste steam from the cylinder of a high pressure engine.

As regards expense, it is admitted by most engineers that but little difference exists between the first cost of the hot water and the steam arrangements, allowing the boilers and pipes to be the best of their respective classes, and the work thoroughly carried out. In the maintenance of the apparatus, however, the economy lies with the hot water system, the boiler there being the only thing subject to wear and tear, and that wear and tear also much less than that of the steam boiler.

## Heating Comparisons.

FROM A REFERENCE HANDBOOK, BY VARIOUS WRITERS, EDITED BY  
ALBERT H. BUCK, M.D.

The advantages of steam and hot water heating in the direct method are, that the heat can be carried a long distance horizontally, and that it can be evenly distributed; rooms near to the distributing centre, or in a vertical line above it, do not rob more distant rooms of their share of it. Nor is there any danger of the air becoming superheated, or "burned," as it is popularly termed. Another advantage is that there is no liability of gases from the furnace fire, nor of cellar air or ground air being carried to the dwelling rooms.

As compared with each other, steam and hot water have each their advantages and disadvantages, on account of which we may prefer one or the other under different circumstances. After weighing these, the writer is led to make the following general statement: That for public buildings and offices steam heating appears most suitable, while hot water is the more agreeable and salubrious method of the two for residences in the Northern States, and the Provinces bordering on the great lakes and ocean. Whether it would answer in the climate of the Northwest is another question. The reasons for these conclusions are based upon the following considerations: Steam is more powerful heat; it requires a smaller amount of piping or radiators; it can be shut off from unused rooms without danger of frost injuring the pipes; when steam is up, an unused room can be more rapidly got ready for use; the temperature can be reduced more rapidly in any individual room by shutting off the steam.

On the other hand, a greater variety and more easy, though slower regulating of temperature, may be obtained with hot water in two different ways. In the first place, the whole water system can be kept at any point between a little above the natu-



ral temperature at the time and a point approaching the boiling point; secondly, by a partial closure of the valve admitting the hot water to the radiator, a very feeble circulation may be produced, whereas with steam, we must have steam — the boiling point of water — or nothing; and a rapid cooling may be obtained when required by opening a window. Rapid cooling of a section of a house may be obtained by running off the water of the main supplying that section, but this can rarely be necessary. The objection to hot water because it is slow in cooling, is a trivial one. The air can never be heated or dried to that unpleasant degree that is seen with superheated steam, or, to a greater degree still, by a hot-air furnace. Of course, by careful attention, moisture can be supplied in either of the three systems, but careful attention is difficult to be obtained, and neglect is less likely to produce a bad result in the hot-water heating. It is a curious fact that many persons with whom we meet forget that the moisture from the inside of pipes does not, continually and intentionally at least, communicate itself to the outside; for leaks are not intentional, and the escape valve of a radiator is not commonly opened for this purpose. Hence we have frequently to remind people that the air around steam-coils is improved by an evaporating pan.

Hot-water heating is estimated to require about one-fourth more radiating surface than steam, hence it is somewhat more costly; while the first cost of both is far greater than that of the hot-air furnace, but less than that of indirect heating by steam or hot water coils and flues.



## About Heating.

BY W. J. THURGOOD, IN "THE NORTH AMERICAN REVIEW."

THE *louver furnace* is simply an enclosed stove outside of, and away from, the apartments to be heated, generally in the cellar or basement of the building. The rising or chimney within which the stove is placed is put in communication with the outdoors not by an open conduit, which serves the double purpose of furnishing air for combustion and for supplying a number of rooms with heated air.

A single furnace may thus heat very conveniently an ordinary dwelling, but the disadvantages and defects of the system are numerous. Beyond a certain limited distance from the furnace the difficulty of conveying heated currents in this manner becomes very rapidly, and where there are branch stoves leading to many rooms, one branch may overpower another, creating excessive heat in one room and a deficiency in another. The proper regulation of apartments is difficult, and the highly heated currents, having no increased capacity for moisture, are apt to convert the rooms to be heated into drying chambers to no extent that is neither agreeable nor healthful. A few years have struggled to produce proper ventilation, without very largely some of these evils. For large buildings several central furnaces must be provided, and the economy is proportionally diminished.

A comparison of these various methods must include the cost of the apparatus, the cost of attendance, the cost of fuel and the respective advantages and disadvantages belonging to each. The open fireplace possesses the advantage of giving thorough ventilation, but it is the most expensive in fuel. The close stove is highly advantageous, in point of economy, where there is little ventilation, and, as this is apt to be the case, it is perhaps the least healthful of all methods as generally applied. Both of these methods become useful in situations as well as in fact, where the heating of dwellings of many rooms is required, and are susceptible to large

structures and public buildings as they are now constructed. The hot-air furnace system is of all the most difficult to manage so far as uniformity and control of temperature is concerned. The danger from fire, the dust, the defective ventilation, and the impracticability of heating more than a limited space by a single hot-air furnace, are other defects inherent in this system.

The special advantages of steam heating are: 1st. The almost absolute freedom from risk of fire when the boiler is outside of the walls of the building to be heated, and the comparative immunity under all circumstances. 2d. When the mode of heating is the indirect system, with box coils or heaters in the basement, a most thorough ventilation may be secured, and it is in fact concomitant with the heating. 3d. Whatever may be the distance of the rooms from the source of heat, a simple steam pipe of small diameter conveys the heat. From the indirect heaters underneath the apartments to be heated, a vertical flue to each apartment places the flow of the low heated currents of air under the absolute control of the occupants of the apartment. Uniformity of temperature with certainty of control may thus be secured. 4th. Proper hygrometric conditions of the air are better attained. As this system supplies large volumes of the air heated only slightly above the external temperature, there is but little change in the relative degree of moisture of the air as it passes through the apparatus. 5th. No injurious gases can pass from the furnace into the air flues. 6th. When the method of heating is by direct radiation in the rooms, the advantages of steadiness and control of temperature, sufficient moisture and good ventilation, are not always secured; but this is rather the fault of design, since all these requirements are quite within the reach of ordinary contrivances.

It is only to be remarked, finally, that the most thoughtful among our physicians and sanitary advisers realize with anxiety the fact that there is a growing abuse of all these systems, except the open fire, in providing too much heat and too little ventilation. There is no mode of heating which lends itself to the correction of

It will be readily, however, as the steam-heating method. With proper care on the part of architect in arranging inlet ducts the fresh air, and venting, have heated by steam coils to accelerate the draft, and desirable degree of ventilation with low temperature rooms may be secured. Such arrangements should, however, be studied in advance, and form practical elements in the design of a building, instead of being wholly subordinated, as is commonly the case, to less important architectural features.

## A New System of Ventilation.

FROM THE *TRANSACTIONS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS*, MARCH 10, 1906.

The great fault of the warm buildings, in France, is to be ventilated by a warm process, the principle being that of maintaining the walls at a higher temperature than the air which they inclose. The reason for which this is accomplished is very ingenious. It is very common to construct houses the masonry wall hot and cold air goes around in the temperature heated. The air is heated over the masonry through a great number of small holes in the floor and in front of the walls. On openings being covered by a fine screen. Before the entrance of air between the walls are thoroughly covered up. Heating air heated to 200° Fahr. is made to flow between the masonry walls behind the building and close to the floor. The walls are then heated to a temperature of 100°, a temperature which, by conduction, will keep the masonry walls between walls ventilating the wall with air to 40° from the heating chamber. All discomfort will doubtless be thus prevented, as the currents of air will all be upward, owing to the heated surfaces.

## “In Hot Water,”

BY JOSEPH A. WOODHULL, ESQ. •

In the early winter of '87 and '88, — after a three weeks' race with the typhoid fever — I was extended on the “Home Stretch,” trying to win my way back to health and strength. Feeling a current of hot air from the furnace, I began to think of the danger of heating in that way. I concluded that, as I had used a furnace twelve years, my house was as dry as a powder magazine, and about as dangerous, which reflection was anything but consoling in the condition I then was, and well calculated to induce serious reflection. I had read scientific articles on spontaneous combustion, and a friend's house that was heated by a furnace caught afire in the evening, when the family were assembled in the sitting room, and they had barely time to escape, losing everything but the clothes they had on. Reflecting on these things, I came to the conclusion that the danger line of conflagration lay very close, when the heat needed to keep a house comfortable in cold weather was generated in a furnace, and the possibility of my house going up in flame and smoke presented a prospect of cremation that did not afford me any pleasure in contemplating. Like most people when sick, I formed a resolution that, as soon as possible, I would reform my way of house heating. I had for years thought of the possibility of heating with steam, but the thought was always “ambushed by fear” of being blown up, so I never got any further than an estimate of what a plant would cost. One day in looking over the ads. in a magazine, I found a florid description of a hot-water heater; I sent for a catalogue, but I was not long in discovering that other manufacturers claimed a hearing also. I soon provided myself with an ample supply of catalogues, each one of which abounded with good reasons why their heaters were superior to all others, backed by a long list of recommendations from their patrons, in which they congratulated themselves on the fact, that, after examining all other

makes, they had decided to take theirs. I read, compared, and digested, until I considered myself qualified to make a choice, which I did, and continued to do, until I had chosen and tried *six*, before I could truthfully say,

" Now is the winter of our discontent  
Made glorious summer,"

for I found in the " Faultless Furman " one that meets all the requirements. It is positively Good, comparatively Better, and superlatively the Best heater I have ever had experience with.

One thing, that is claimed in common by all manufacturers of hot-water heaters, I can most cheerfully indorse, and that is, that a well constructed, properly arranged hot-water plant is the best system for heating dwelling houses known to modern science. It is the " Gold Stream " domesticated.

Of the truth of this I became convinced in using the first heater I tried, or I never should have submitted to the inconvenience, and incurred the expense, which these repeated changes caused. Regarding the heaters that I tried and discarded, the manufacturers no doubt believe me in fault; or a crank, or both; but I succeeded in getting a plant that is ample, pleasant, and perfectly safe from danger from fire or frost; and I feel that the result has justified the trouble and expense.

In conclusion I would say that what I have learned in regard to hot-water heating, I have learned in the most expensive way that information can be obtained, and that is, in the school of experience, but unfortunately for me there was no other way.





## Heating Questions, Answered.

BY FRANCIS A. HERENDEEN, GENEVA, N.Y.

How shall I heat my house?

Everybody sooner or later asks this question —

The answer: Use a hot-air furnace, steam heat or a hot-water system. Many people combine the last two.

Which is the cheapest?

First cost only considered, — hot air, unless you use stoves.

Then why is the use of the other systems constantly increasing?

Easily told, because, leaving out the question of first cost, they are admittedly the most healthful, and give a far pleasanter and even heat, with an abundance of pure fresh air, and, besides, are vastly more economical in fuel.

In selecting a steam or hot-water apparatus, what is the most important feature to consider?

The boiler, as it is the very heart and life of the entire system.

Aren't all boilers about alike?

No, there are scarcely any two built the same way. Some are made of wrought-iron, and some of cast-iron: Some are tubular, and some are sectional: Some are made with "packed joints" and some with "screwed joints." Some have plain grates, from which it is difficult to remove clinkers, others improved rocking grates, and so on.

How can I tell which is the best?

By getting thoroughly informed on each under consideration.

For instance, examine the difference between "packed joints" and "screwed joints." The former never can be relied upon and sooner or later are bound to give out and leak. Only lathe-

boxed screwed joints are half iron to iron (the longer used the lighter they become). Remember this above all others, that the weakest joints about all boilers or radiators are their joints. Therefore look to them carefully.

What is a "packed joint"?

A packed joint is a connection made between two water openings by means of a gasket or washer of paper, asbestos, rubber or some other "spongy" material placed around the opening between the two parallel faces of the iron and the entire joint made tight by pressure, generally by bolting the two faces together.

Then why is a "packed joint" unreliable?

Because the constant stress it is subjected to by expansion and contraction, such destroys the elasticity of the packing; the constant heat runs it out, and sooner or later it becomes worthless, causing leakage, and involving the trouble and expense of repacking. Frequently they give out in the middle of winter. Remember also that all boilers of this type contain from ten to twenty lbs. of steam.

Then why aren't boilers made without joints?

Because it is impossible to produce a boiler made in one piece that would be practicable and bear the heat continuously, and therefore it must be made in sections put *together* by means of some kind.

What kind of joints are best?

Leak-proof *horizontal* joints throughout, they will never leak.

How also be boilers built?

Well, to sum up. Our water surfaces are *horizontal* — arranged over the fire; and to collect, they are *vertical*.

Are horizontal surfaces better?

Decidedly not. All horizontal surfaces are *also* covered with a layer of low soot and ash, and so prevent the heat being ab-

sorbed easily by the water, causing immense waste of fuel. The accumulation of a quarter of an inch of soot requires 50 per cent more fuel than would be necessary if the surfaces were clean.

But can't they be cleaned ?

They can be, yes ; but in the average house, where the boiler is left to servants, they are not. "Cleaning the boiler" is a dirty, disagreeable job, filling the cellar with dust and soot, and the practical result is the boiler is left to "do the best it can" by itself.

But what about "vertical surfaces" ?

They are necessarily perpetually clean. Being vertical, there is no place where dust can lodge and collect, and therefore they greedily absorb heat from the fire, and the smoke passes off cool.

But supposing the "vertical surfaces" are in the form of flues — vertical flues — what then ?

Ah, then these flues will choke up. All flues will choke up, whether horizontal or vertical, and need constant cleaning. What we mean by vertical surfaces that will be constantly clean are *convex* vertical surfaces, such as the outside of tubes filled with water.

Are wrought-iron boilers preferable ?

Not for heating purposes ; for where a boiler lies idle half the year, as in a damp cellar through the summer months, it rusts out rapidly. Cast-iron, as is well known, is not nearly so susceptible to corrosion as wrought-iron, and is therefore practically indestructible.

Of what material should a heating boiler be constructed ?

The best of cast-iron throughout, and every boiler should be tested to a pressure ten times greater than it ever will be subjected to at any time when it is in operation. With ordinary proper care it should last a life time. Every inch of its iron in any way exposed to the fire should be constantly backed by *solid water* so that it cannot burn out nor rust out.

In a hot-water system what is most essential ?

A rapid flow of water through the pipes and radiators.

Why so?

Because the faster the water travels the hotter will be its average temperature, and the more heat will it impart to the house.

What causes the water to circulate?

Heat.

What retards its circulation?

Friction.

What creates friction?

Sharp turns of the pipe, bad valves, poorly constructed radiators, but most of all a *horizontal movement* of the water through the boiler.

Why does a "horizontal movement" of the water through a boiler create friction?

Because when water is heated, it at once begins to expand and rise — *straight up* — and if it has to move in a zigzag way through the boiler, before being liberated into the flow pipes, the contact of the water with the horizontal surfaces of each section through which it passes creates great friction, and, consequently, its velocity is greatly retarded.

How, then, should a hot-water boiler be constructed so as to produce rapid circulation?

It should be constructed so that every particle of water, from the moment it commences to absorb heat until it is discharged into the flow-pipes, must move *vertically* through the boiler.

Thereby the minimum of friction and maximum of velocity of the water are obtained.

What makes "economy of fuel"?

Three things: First, perfect combustion; second, rapid transformation of fire-heat into water-heat; and third, the least waste of heat from the boiler into the cellar.

What promotes "perfect combustion"?

A fire-box so constructed that the fire will burn evenly, as well at the edge as at the center, and a draft sufficient to give an ample supply of oxygen for the complete combustion of all the gases generated.

What promotes "rapid transformation of fire-heat into water-heat"?

Three things: First, The fire must lie in the midst of and be surrounded by water surfaces.

Second, The flames and hot gases must impinge, or strike, against these surfaces at right angles, and

Third, The water must be cut up into small portions so as to rapidly absorb heat. For instance, you can boil a quart of water on a stove much faster if you divide it into two portions of a pint each.

What prevents waste of heat from the boiler into the cellar?

Setting the boiler in brick-work, or, if it is a "portable style," then encasing it in easily removable asbestos and iron jackets.

Aren't all portable hot-water boilers so encased?

Very few, scarcely any.

How should an ideal boiler be encased?

It should have three jackets: A heavy inner one of black sheet iron, a middle jacket of pure asbestos, and an outer one of galvanized iron, separated by an inch and a half air space from the inner jacket.

Will these three jackets keep in the heat successfully?

Yes, almost entirely. The outer galvanized iron jacket should rarely be so warm but that you may comfortably rest your hand on it.

How much heat would be wasted in the cellar without such jackets?

Sufficient to warm three ordinary good-sized rooms.

Then why aren't all portable boilers supplied with them?

Because they add to the cost of the boiler, and unless attention was called to their omission, many people would not know that they were desirable.

Which style of boiler is usually preferred?

For office and residence heating the "portable" style. For larger work such as halls, theaters, churches, large greenhouses, etc., the "brick-set" style.

How can you have a cool smoke pipe?

By making the boiler into a "Base Heater," so that all the smoke before passing into the chimney is drawn down to the bottom of the boiler in the rear and thereby comes in contact with a great deal of water surface before it enters the chimney.

Moreover, this last water it comes in contact with is the cool RETURN water, and so very rapidly absorbs heat from the smoke and reduces its temperature.

What do you mean by a "Combination System" of steam and hot water?

A system by which you can at pleasure warm your house by either steam or hot water, simply opening a valve to draw down the water to the proper level when you wish to use steam, and filling up the boiler and radiators again, by opening another valve, when you wish to run as hot water. Hot water is intended to be used during spring and fall, and steam during zero weather.

How do the various systems range in price?

The cheapest is steam, then comes the "combination" and then hot-water. The price of the boiler alone, however, in each case is practically the same.

Are there other points to consider before deciding what boiler I shall buy?



Yes, many; for instance, the ease of cleaning from clinkers or dust, the ease of regulating, whether the boiler is sufficiently low in height to go into a low cellar, whether it can be taken apart to go through narrow doors or passages, whether it is a "base burner," whether it is a "self-feeder" or a "surface burner," whether it will prove durable and not need constant repairs, and whether it is simple enough "to run itself," so that any ordinary servant can take care of it with safety.

#### SUGGESTIONS ABOUT RADIATORS.

There are perhaps half a dozen different styles of first-class radiators now on the market, any of which are likely to give satisfaction if they are generously used, so as to easily and comfortably warm your house. One of the most common sources of trouble, wherever work is let by contract to the "lowest bidder," is that of *insufficient radiation*, the contractor taking his chances on a mild winter, or his power of persuading you that he has given you enough. The larger your radiators, the easier and quicker are your rooms warmed, especially so on a cold winter's morning.

The best plan is to have a distinct understanding with your steam fitter as to the exact number of square feet of radiation he will put *in each room*, and be sure and have your front hall well heated in any event, for a warm hall goes a long way towards a comfortable house.

#### ADDITIONAL SUGGESTIONS.

**VALVES.** — Use only the best, full-opening, angle valves with Jenkins' disk, nickel-plated all over, rough body, wood wheels, with unions. It is economy in the end to use only first-class valves.

Have plenty of boiler power, so that you will not be obliged to crowd your boiler in severe weather. The most successful and economically running jobs have ample boiler and radiator capacity.

Wherever pipes run through walls, floors, or ceilings, use nickel-plated or cast-iron (bronzed) plates to give a neat finish.

# The Evolution of Home Warming.

BY FRANCIS A. HERENDEN, GENEVA, N.Y.

(Reprinted from *The Herenden Mfg. Co.'s Catalogue*, 1891.)

Warming by artificial means is accomplished in a variety of ways. Starting primarily from the open fire, there have been evolved in succession stoves, hot-air furnaces, and the modern systems of steam and hot-water heating.

## OPEN FIRE-PLACES.

The open fire was the original, and for many centuries the principal source of heat in all civilized countries ; but while it gives a genial and healthful warmth, and in connection with steam or hot water is very desirable for comfort and cheer, as a primary and independent source of heat it is a failure. The amount of warmed air which is carried up the chimney, and the amount of cold air drawn into the room around the windows to take the place of the air drawn out, is so great that it renders the house in cold weather uncomfortable, so that, as an independent source of heat, the open fire is practically valueless.

## STOVES.

Next, and greatly superior in heat producing qualities, are the various forms of stoves. With these no more air is removed from the room than is necessary for combustion ; and heat is retained in the stove sufficiently long to radiate a very considerable portion of it into the room.

In the open fire-place only one-tenth of the actual heat generated is utilized in producing warmth, while in a stove about one-half of the heat is utilized for that purpose.

There are many objections to the use of stoves. Among them may be mentioned : —

(1) Nearly as many stoves have to be used as there are rooms to be warmed, thus entailing the necessity of caring for many fires.

(2) The coal must be brought in and the ashes removed from each individual stove daily ; work, as every good housekeeper knows, accompanied by dust and dirt, to the injury of oil-cloths, carpets, furniture, and temper.

(3) They are not automatically self-regulating, but give a constantly varying quantity of heat, and need frequent attention in order to preserve an even temperature in the room.

(4) The escape of poisonous gases into the room is very injurious to health and is a serious objection.

#### HOT-AIR FURNACES.

Next in order of excellence are the hot-air furnaces. These, while much superior to stoves in many respects, and very properly taking their places, are still open to many serious objections, among which are the following : —

(1) It is impossible to successfully warm rooms situated on the windward side of the house, as the pressure of the hot air coming into the room through the registers is so slight, that it is easily overcome by the pressure of the wind around the windows and doors, and thus there is often caused a downward current of cold air through the registers, instead of a warm one upward. No matter how important, it is practically impossible to keep a room warm which is situated on the windward side of the house.

(2) If the hot-air pipes are carried to the second floor, the strong tendency of the longer pipes to take the heat is so great, that it is found difficult to equally and uniformly distribute the heat on all the floors.

(3) It is impossible to carry heat to any considerable distance horizontally, and therefore remote parts of the house must be heated with stoves.

(4) All furnaces, and especially old ones, give out gas, particularly when the combustion is slow, and a very considerable amount of this poisonous gas is constantly escaping into the rooms.

(5) All furnaces throw more or less dust, and hence become a fruitful source of trouble to tidy housekeepers.

(6) The plates of a furnace, being subjected to the intense heat of nearly or quite 1,000°, rapidly become warped and burnt and the joints loosened, so that they have to be replaced in whole or in part in a very few years.

(7) Owing to the excessive heat of these plates, as before mentioned, the surrounding air is rendered exceedingly dry and vitiated by the partial removal of its oxygen, — the life-giving property, — and is utterly unlike the natural warmth of summer weather, the peculiar charm observed in houses warmed by steam or hot water.

With steam, the heated surfaces are but little over 212°, and in consequence the air warmed by them is not deprived of its moisture, but has almost the exact qualities that nature gives us in pleasant summer weather. This is even still more noticeable with a hot-water system.

The amount of "heating surface" is so small in a furnace, that the smoke enters the chimney at a very high temperature and with a corresponding waste of fuel. In point of economy, therefore, furnaces are not to be mentioned in comparison with a steam or hot-water apparatus, from which the smoke enters the chimney at a very low temperature.

#### STEAM AND HOT WATER.

The heat from steam is almost exactly identical with that from hot water, and few can distinguish between the two systems when properly erected.

They are both healthful, economical, and satisfactory methods of home warming, and possess none of the objections mentioned as belonging to furnaces or stoves.

They give out neither gas, dust, nor smoke, are automatically regulated, and therefore allow of an even and constant temperature

throughout the house, whatever be the condition of the weather outside.

The system, when once properly set, will be permanent, not liable to get out of order, cause trouble and annoyance, or need early repairs.

It will run noiselessly and uniformly, giving a constant supply of pure fresh air, free from dust and smoke, and particularly free from all poisonous gases.

Steam and hot-water heating have long been acknowledged by physicians, architects, and builders as altogether the most practical, healthful, and economical in every way — and their now universal adoption in all the better class of buildings throughout the country is conclusive proof of their superiority.

#### A HEALTH STANDPOINT.

The importance, from a health standpoint, of a low temperature in the body or surface giving off heat can scarcely be overestimated. It can perhaps be best shown by illustration and comparison with a hot-air furnace.

With a furnace burned air is served into a room at a temperature of from 300 to 500 degrees and upwards. Air at this temperature is rendered exceedingly dry, and becomes vitiated by the partial removal of its oxygen, the life-giving property. Moreover, moving as it does at such a high rate of speed, it bounds instantly to the top of the room and there remains, so that while the upper air may have a temperature of 90 degrees, or even 100 degrees, that near the floor will not be over 50 or 60 degrees hot. This unevenness of heat is readily seen to be productive of sickness, and is a constant source of danger.

Warmth from either steam or hot water, on the contrary, is uniform and mild. An equal amount of heat is imparted to the air in the room in one case as in the other, but it is derived from a comparatively large body of heating surface, having a low temperature.

The currents of warmed air circulate by convection uniformly

to and from the radiators, and there is consequently little difference in temperature between the air at the top and at the bottom of the room. With people who are troubled with cold feet this is very important.

Home-warmth derived in such a manner is strictly analogous to the natural heat of summer, where no difference in temperature is experienced in any part of the room.

This point, in our judgment, is by far the most important in the entire discussion, as upon it depend the comfort and health of every member of the household.

#### THE LATENT HEAT OF STEAM.

It is a curious scientific fact, that in the production of steam from water, nearly 1,000 degrees of heat are absorbed, and rendered latent, without increasing the sensible temperature as indicated by a thermometer.

To illustrate: If to a certain quantity of water at  $32^{\circ}$  Fahrenheit, a uniform quantity of heat be applied, and it takes ten minutes to raise the water to  $212^{\circ}$ , or the boiling point, and the same uniform quantity of heat is continued until the water is entirely evaporated, it will be found that it has taken about five and one-half times as long to evaporate the water as it did to raise its temperature from  $32^{\circ}$  to  $212^{\circ}$ , while the steam itself at no time has indicated a sensible temperature of more than  $212^{\circ}$ .

Now it is evident that during the first ten minutes the water received  $180^{\circ}$  of actual heat; therefore, during the time it is being entirely evaporated, it will receive five and one-half times more than it received the first ten minutes, or,  $5\frac{1}{2} \times 180^{\circ} = 990$ .

The question what has become of this large amount of heat is easily answered. It has become latent and entered into the steam, but in so doing it has not increased the sensible temperature of the steam a particle.

When this steam is again condensed, as in the radiators, and is returned again to water, these absorbed 990 degrees of heat are



entirely liberated and given off in the process of condensation, for the condensed water still retains the same temperature, 212°.

Therefore, by the passage of steam through pipes into distant rooms, all the heat of the steam is liberated in the radiator, in the apartment in which the heat is needed.

The following table gives the temperature of steam at different pressures, as shown by a steam gauge. Atmospheric pressure is included : —

POUNDS.	DEGREES.	POUNDS.	DEGREES.	POUNDS.	DEGREES.	POUNDS.	DEGREES.
0	212	4	225	9	237	30	274
$\frac{1}{3}$	213	5	228	10	240	40	287
1	216	6	230	15	250	50	298
2	219	7	233	20	259	75	320
3	222	8	235	25	267	100	337

#### TO GET BEST RESULTS OUT OF YOUR BOILER — HINTS ON SAVING FUEL.

1st. During mild weather, when you only want a little fire, keep the front feed door slightly open by placing a piece of coal under the same. This will act as a cold air check, and will hold back the fire. If, however, you are burning *soft* coal, we sometimes find that opening the front door as above makes the fire burn *better*, as it supplies more air and *aids* combustion.

2d. If your boiler is a magazine burner, during the fall and spring months run it as a *surface* burner, and do not fill the magazine with coal. The magazine feed is particularly intended for the colder months, so that fire may be carried longer without attention.

3d. In mild weather do not shake the grate very much, but let the fire smoulder.

4th. Keep the ashes shovelled away from the grate, and before you start up in the fall, brush out all the soot which has collected in the smoke pipe and bottom of the chimney.

5th. See that the jackets fit tightly, and that the smoke pipe fits

snugly into the chimney. If it does not, close up all cracks with a little stove cement, or fire clay, also all holes around the bottom of the boiler, where the pipes may come through the casing.

6th. It is advisable to cover the dome with either asbestos cement two inches thick, or else three or four inches of clay or ashes — and be careful to cover and thoroughly protect *all pipes exposed* in the cellar or boiler room, by hair felt or mineral wool, or other non-heat-conducting substance. This will save a large amount of heat, and will make a difference in your coal bill of about 20 to 25 per cent.

#### HINTS ON THE MANAGEMENT OF STEAM RADIATORS.

1. In letting the steam into a radiator, open the valve *wide*, never partly; if in mild weather, do not open the air cock; if in cold weather, open the air cock just enough to hear the air hiss slightly, and if the piping is done rightly you will get no water upon your carpets; it is better not to open the air cock until there is no rushing sound in the radiator after opening the valve.

2. In shutting off the steam, shut the valve *tight*, never leave it partly shut, as then the steam condenses in the radiator and fills it with water, and consequently diminishes the water in your boiler.

3. If the water is out of the glass tube, never under any circumstances turn on cold water into the boiler, but dump the fire, or throw on ashes, closing the draft, and leave the boiler to itself until it gets cold, or nearly so; then let in the water gradually until it is within an inch or so of its proper height; then, if you do not discover any leaks, build a fire, and feel satisfied that your boiler is all right.

4. Never feel alarmed if the steam is escaping from the safety-valve, but see if the draft is shut; if it is, let the steam into one or two radiators; then if it does not stop, put on more coal, or let in more water slowly, if it has not fallen below the glass tube.

5. Try the safety-valve occasionally to see that it works properly.

# How to Properly Estimate a House.

## For Either Steam or Hot Water.

BY FRANCIS A. HERENDEEN, GENEVA, N.Y.

The amount of radiation to be placed in a house depends not so much on the quantity of air in the building, as upon the area and nature of the exposed outside surfaces, such as windows, walls, doors, etc., and their cooling effect upon the house.

It is evident that small rooms or small houses have a much greater amount of exposure per cubic foot of space than large rooms or large buildings. For example: A building 30x40 ft. and 25 ft. high will contain 30,000 cubic feet of space and have 3,500 square feet of exposed wall surface. While a building 75x100 ft. and 40 ft. high will contain ten times the space of the first building, or 300,000 cubic feet, *and yet have only four times* the area of exposed wall surface, or 14,000 square feet.

If the smaller building may be warmed by 500 sq. ft. of radiation, the larger one, if it be similar in style and shape, will be equally warmed by four times that amount, or 2,000 sq. ft. of radiation. In the first case the proportion according to contents is one foot of radiation to 60 cu. ft. of space, while in the latter case it is one to 150, or  $2\frac{1}{2}$  times as much as the former, which is the exact ratio of the increased capacity to the increased exposure.

In this comparison the exposure of the roof is not counted, as it would be practically neutralized by the attic or garret in either case.

While, therefore, the true way of estimating buildings is solely by exposure, for ordinary residences, where the ratio of the exposure follows pretty closely that of the cubical contents, it has been customary for greater convenience, to estimate them by cubical contents, with such additions to or subtractions from the result obtained as may suggest themselves to the experienced engineer by considering the special exposure as to winds, etc., or the character of the structure, etc.



## INDIRECT RADIATION.

FEET OF HEATING SURFACE.	AREA COLD AIR SUPPLY.	AREA HOT AIR FLUE.	SIZE OF REGISTER.
SQUARE FEET.	SQUARE INCHES.	SQUARE INCHES.	INCHES.
13	36	48	8 × 12
26	54	72	9 × 12
39	72	96	10 × 14
52	90	120	12 × 15
65	108	144	12 × 19
78	126	168	14 × 22
91	144	192	14 × 24
104	162	216	16 × 20
117	180	240	16 × 24
130	198	264	20 × 20
143	216	288	20 × 24
156	234	312	20 × 24

TABLE OF PRESSURE IN POUNDS, A COLUMN OF WATER EXERTS  
PER SQUARE INCH.

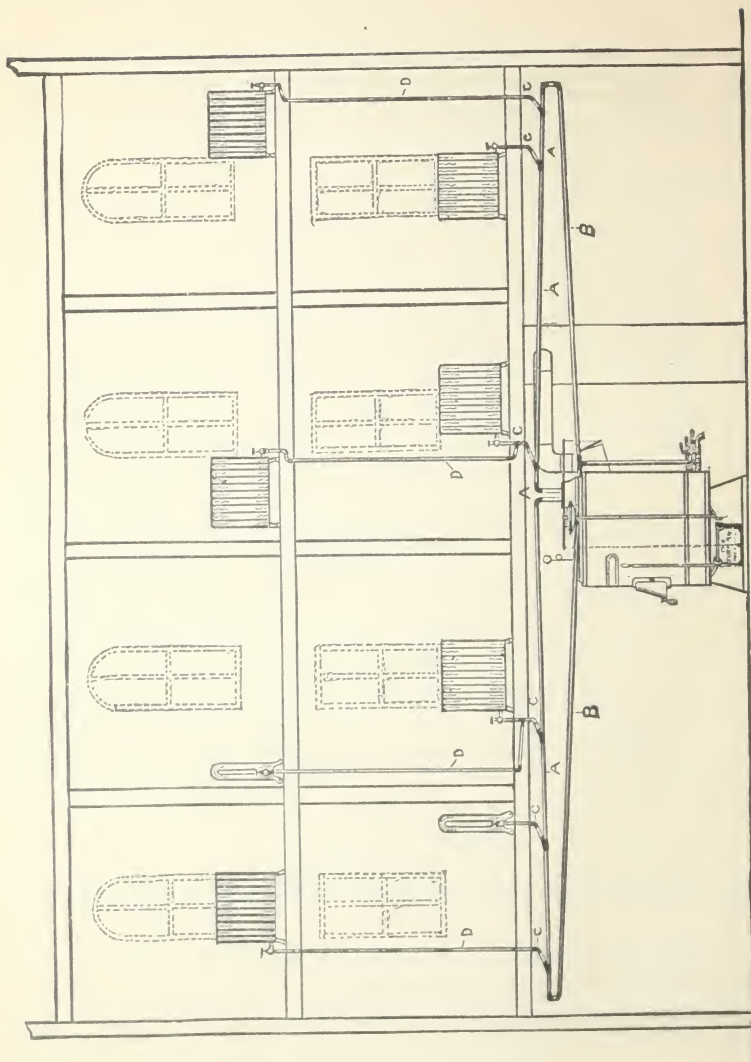
FEET HEAD.	EQUALS PRESSURE PER SQ. INCH.	FEET HEAD.	EQUALS PRESSURE PER SQ. INCH.	FEET HEAD.	EQUALS PRESSURE PER SQ. INCH.	FEET HEAD.	EQUALS PRESSURE PER SQ. INCH.
1	0.34	15	6.49	30	12.99	45	19.49
5	2.16	20	8.66	35	15.16	50	21.65
10	4.33	25	10.82	40	17.32	55	23.82

### Useful Information.

A gallon of fresh water weighs 8 1-3 lbs., and contains 231 cubic inches.

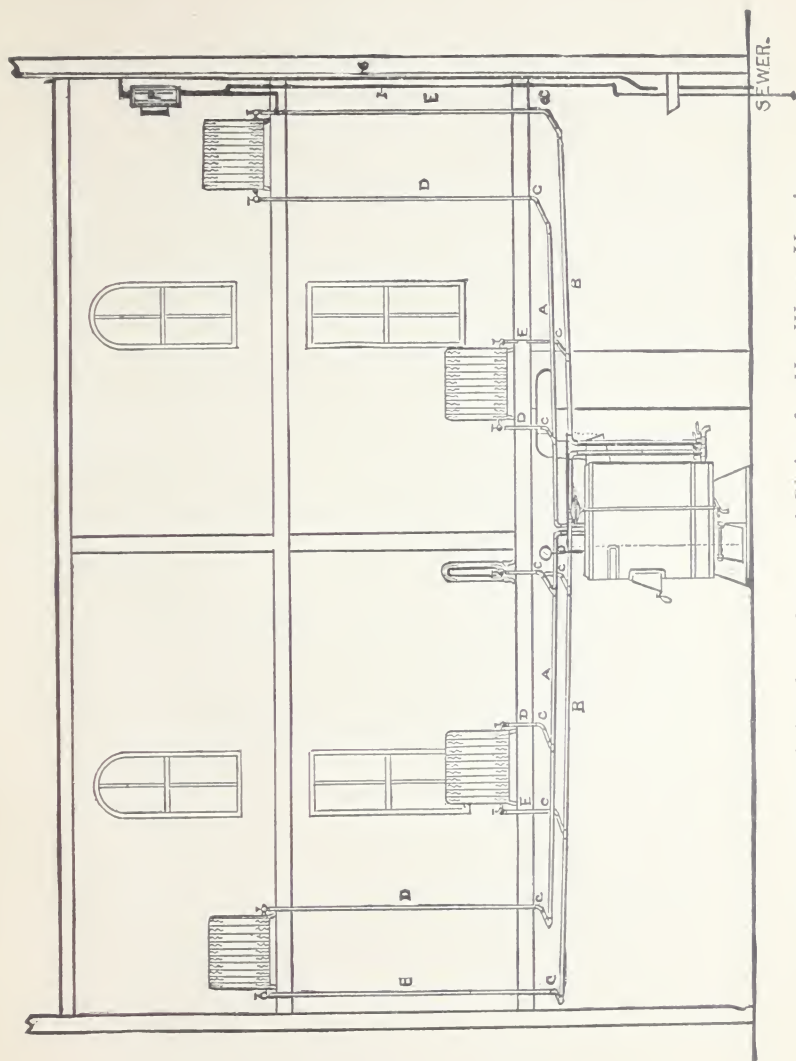
A cubic foot of water weighs 1,000 ounces, or 62 1-2 lbs. and contains 1,728 cubic inches, or 7 1-2 gallons.

Doubling the diameter of a pipe increases its capacity four times.



We recommend the above System of Piping for Steam Heating.





We recommend the above System of Piping for Hot Water Heating.

# STANDARD WROUGHT-IRON PIPE—FOR STEAM AND WATER.

$\frac{1}{16}$  inch wall thickness, both inside and outside, is assumed for all pipes per square inch of hydraulic pressure.  
 14 feet and above, half section, 14 feet and above, half section, 14 feet and above, half section.

TABLE OF STANDARD SIZES.

Nominal Diameter, Outside.	Thickness.		Interior Area, in Squares.	Factor of Safety, as Prescribed by the U. S. Navy.	Lap Joint, per Square Foot of Interior Surface.	Strength, in Tensile, per Square Foot of Pipe.	Coefficient of Expansion, per Foot.	Weight, in Pounds, per Foot, of Pipe.	No. of Turns, per Inch, of Pipe.
	Inside.	Outside.							
$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{8}$	3048	2.032	4.556	.221	.0102	$\frac{1}{16}$ —0.84	14
$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{4}$	5233	3.298	3.637	.274	.0290	$\frac{1}{8}$ —1.126	14
$\frac{3}{8}$	$\frac{1}{4}$	$\frac{3}{8}$	8027	4.134	2.603	.344	.0408	$\frac{1}{4}$ —1.070	11 $\frac{1}{2}$
1	$\frac{3}{8}$	1 $\frac{1}{8}$	1400	5.215	2.301	.434	.0638	$\frac{3}{8}$ —2.268	11 $\frac{1}{2}$
1 $\frac{1}{2}$	1	1 $\frac{3}{4}$	2008	5.660	2.010	.497	.0618	$\frac{1}{2}$ —2.004	11 $\frac{1}{2}$
2	1 $\frac{3}{8}$	2	2835	7.401	1.611	.621	.1032	$\frac{3}{4}$ —3.467	11 $\frac{1}{2}$
2 $\frac{1}{2}$	2	2 $\frac{1}{2}$	4.785	9.002	1.398	.752	.2550	$\frac{7}{8}$ —5.175	8
3	2 $\frac{1}{2}$	3	7.308	10.00	1.001	.910	.3073	$\frac{15}{16}$ —7.547	8
3 $\frac{1}{2}$	3	3 $\frac{1}{2}$	9.857	12.50	.855	1.044	.4008	$\frac{15}{16}$ —9.035	8
4	3 $\frac{1}{2}$	4	12.700	14.13	.840	1.178	.6228	$\frac{15}{16}$ —10.728	8
4 $\frac{1}{2}$	4	4 $\frac{1}{2}$	15.608	15.20	.703	1.390	.8293	$\frac{15}{16}$ —12.402	8
5	4 $\frac{1}{2}$	5	19.000	17.47	.626	1.553	1.0200	$\frac{15}{16}$ —14.564	8
6	5	6	28.880	20.81	.577	1.753	1.5500	$\frac{15}{16}$ —18.767	8

Manufacturers' revised price-list. Adopted April 13, 1893.



